SYMONS'S

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THE CHRISTMAS FROST OF 1870-71.

IN accordance with the precedent of 1867, we this month devote considerable space to records of the recent frost—we might almost say the present, for up to this date, January 12th, it has hardly broken.

We think it may be expedient to say a few words by way of preface (1) on what we deem the limits of editorial responsibility with reference to returns of this nature, and (2) on causes of discrepancy.

It is very customary to prefix to the correspondence columns of journals, and to the whole volumes of papers published by scientific societies, a notice that the editor or society, as the case may be, "is not responsible for the facts and opinions stated in the following papers." Possibly this notice has some legal force, if so, we also hereby repudiate responsibility. We should not have referred to this subject had not a very eminent gentleman, who, unavoidably, has published as many erroneous observations as we have, lately said that he "looked at it as a very serious thing that people will publish observations without having satisfied themselves that those observations are correct." How is it possible to do this? There is not an observatory, public or private, where all the observations are correct, and it is mere affectation to assume that it can be otherwise.

Mr. Glaisher and Mr. Buchan, by visiting the various stations and examining all the instruments and their positions, Kew Observatory, by testing the instruments before use, and Mr. Symons, by touring about among the rain gauge stations, each do what they can to ensure an approach to accuracy, and if they use reasonable care in printing the returns we do not see what more could be expected. But surely none of them would presume to say that the observations they publish *are* correct. They may strive to minify the sources of error, but they cannot exclude them. Why even Mr. Griffith might read a thermometer 2° or 3° too low, and who could detect it? Hence we repudiate responsibility, because we cannot "satisfy ourselves that the observations are correct." We are confident that our correspondents are, at least, the equals of any existing body, but they, we, and all mortals, not excepting our critic, are fallible.

Minimum Temp. in Air from December 22*nd*, 1870, *to January* 1*st*, 1871.

Station.	Observer.	22	23	24	25	26	27	28	29	30	31	1
Middlesex-Bot.Gar Regent'sPk.	W. Sowerby, Esq. ..	22·5	17·0	14·0	12·0*	23·0	22·0	25·5	21·0	18·5	17·0	21·0
Camden Square	G. J. Symons, Esq. ...	23·2	18·6	15·3	14·0*	27·2	21·7	24·0	25·0	19·8	18·2	21·0
Hayefield Park, Uxbridge	W. F. Vernon, Esq	...	...	...	10·0*	...	...	...	..	...	...	...
Surrey—Pyports, Cobham	G. Dines, Esq.	...	...	...	...	..	...	..	...	...	1·2*	...
Kent—Riverhead, Sevenoaks ...	Rev. J. B. Murdoch ...	...	..	...	4·0*	...		..	...	...	...	...
Bromley Common	Rev. A. Rawson	...	...	...	4·0*	...	...	...	...	...	...	...
Chiselhurst	F. Nunes, Esq.....	22·0	14·5	11·7	10·2*	11·3	21·9	23·4	21·9	15·4	12·3	14·3
Foxgrove, Beckenham	P. Bicknell, Esq.....	22·9	13·3	9·3	6·0*	26·4	18·0	24·3	20·8	11·3	6·0*	13·8
Eltham Green	Mr. E. J. C. Smith ...	23·6	16·0	10·9	9·1	12·8	20·8	25·6	21·0	11·2	15·0	14·8
Greenwich Observatory	J. Glaisher, Esq.	20·4	17·6	15·3	9·8*	22·7	22·0	25·4	22·0	19·0	15·8	19·2
Crossness	F. E. Houghton, Esq..	...	...	...	9·0*	..	...	...	...	...	9·0*	...
Sussex—Worthing	W. J. Harris, Esq. ...	24·0	19·4	21·2	21·1	23·4	23·4	23·6	26·3	18·9*	19·9	20·9
Hants—Newport, I. of W.	E. G. Aldridge, Esq ..	...	...	19·0*	...	...	...	...	...	...	21·5	...
The Vyne, Basingstoke	DeWiggettChute,Esq.	...	9·0	4·0	2·0	9·5	10·0	12·0	19·0	3·0	3·0	—2·0*a*
Strathfield Turgiss	Rev. C. H. Griffith ...	20·5	11·2	7·4	4·0	6·4	10·7	20·5	23·1	6·3	4·0	2·7*
Herts—Berkhampstead	W. Squire, Esq.	21·5	15·5	9 5	6·0*	19·0	19·0	26·0	26·0	11·5	12·5	9·0
Cambridge—Abington Pigotts...	G. Pigott, Esq.	...	...	...	...	...	...	...	...	...	6·5*	...
Cambridge Beech Ho.	J Nutter, Esq.	...	...	...	10·0*	...	...	...	...	...	...	...
Essex—Audley End	Mr. J. Bryan	...	...	...	4·8*	...	...	...	...	...	...	..
Suffolk—Culford	Mr. P. Grieve	...	...	...	1·0*	...	...	...	...	...	...	...
Norfolk—Dickleboro', Diss ...	Mr. F. Dix	...	...	4·0	0·0*	17·0	18·0	20·0	22·0	12·0	9·0	...
Shadwell Court, Thetford	*The Times*	...	...	...	—3·0*	..	...	...	...	...	...	...
Stanford Vic., Watton	,, ...	...	12·0	5·0	—9·0	—8·0	19·0	...	...	...	...	...
Wereham, Brandon	Mr. F. R. Hawkes ...	7·8	8·3	3·2	1·9	19·0	15·8	16·8	20·0	12·0	4·8	...
Norwich	C. M. Gibson, Esq. ...	...	...	8·5	5·5	...	...	..	...	...	...	...
Reepham	*The Times*	...	13·5	0·0	—2·0	14·0	...	...	...	...	...	...
Hillington Rec., Lynn	Rev. H. Ffolkes	...	12·0	4·0	5·0	28·0	20·0	14·0	29·0	11·0	9·0	3·0
,, Hall, ,, ...	,, ,, ...	...	5·0	—5·0	...	...	...	...	...	...	...	—1·0
Wilts—Imber, Salisbury Plain...	Rev. W. Slatter	...	...	10·0*	...	...	..	...	...	...	12·0	...
Pen Hill, Swindon	T. Arkell, Esq.	...	...	...	...	...	...	...	...	...	..	1·0
Dorset—Frome Vanchurch	Rev. P. H. Newnham	...	...	7·7*	...	...	...	...	...	...	. .	...
Longthorns, Blandford	J. C. Mansel, Esq. ...	...	...	7·0*	...	...	...	...	...	...	...	...
Devon—Dartmoor	Mr. Watts.....	..	15·0*	...	...	...	...	...	...	..	...	..
Sidmouth	S. Chick, Esq.	...	18·0*	...	...	...	...	...	...	...	..	...
,, (Belgrave)	Dr. Mackenzie	22·8	19·4	21·2	22·4	22·7	25·3	25·3	29·0	25·5	21·2	...
Meshaw, S. Molton.....	Rev. W. H. Karslake..	...	13·0	...	...	...	..	...	...	...	13·0	...
Great Torrington	Rev. S. Buckland ...	...	...	...	...	...	...	...	...	...	...	19·0
Somerset—Bath...	Dr. Barter.....	...	...	13·3	...	...	...	...	...	...	...	...

Station.	Observer.	22	23	24	25	26	27	28	29	30	31	1
Gloucester—Cheltenham	F. Layard, Esq.	...	...	7·0	...	...	...	...	...	...	8·0	12·0
Boyce Court, Newent	Gen. Drummond	19·0	11·0	5·5	4·5*	12·0	12·0	18·0	27·0	17·0	5·5	8·0
Hereford—Hampton Ho.	*The Times*	...	10·0	6·0	3·0	15·0	...	...	...	...	...	...
Rocklands, Ross	J. M. Herbert, Esq.	...	...	...	..	...	...	...	...	...	0·0	...
Stafford—Enville, Stourbridge	*The Times*	...	..	2·0	—1·0	20·0	15·0	...	...	...	...	...
Wolverhampton	J. Thrustans, Esq.	19·5	13·7	12·9	9·3	12·3	14·7	18·4	23·6	18·0	7·2	4·9*
Church Eaton, Penkridge	Rev. F. Pyndon Lowe	...	—4·0	5·0	4·0	...	...	...	...	...	...	..
Worcester—Bromsgrove	G. Dipple, Esq.	..	...	...	5·8	...	...	...	...	..	...	...
Moseley	T. Plant, Esq.	...	...	...	8·0	..	...	...	..	...	...	...
Warwick—Leamington	S. U. Jones, Esq.	...	...	...	8·0	...	...	...	...	...	...	...
Birmingham	D. Smith, Esq.	...	...	10·7	...	...	..	...	...	...	11·0	...
Leicester—Belmont Villas	H. Billson, Esq.	18·0	12·5	9·0	7·0	22·0	18·5	...	...	...	...	...
Freeman's Comm., Leicester	,, ,,	15·0	12·0	6·0	5·0	...	...	...	...	...	...	...
Lincoln—Boston	Dr. Adam	23·2	15·2	11·3	11·4	14·0	24·6	27·0	29·2	17·2	9·0	4·0*
Bucknall, Horncastle	W. Carter, Esq.	21·5	14·5	2·0	5·0	21·0	23·0	23·0	29·0	21·0	11·0	...
Appleby, Brigg	Rev. J. E. Cross	...	—0·4	6·3	..	...	...	...	..	...	...	...
Nottingham—Highfield Ho.	E. J. Lowe, Esq.	...	12·3	10·9	6·1	26·7	...	...	...	...	...	...
Ollerton	H. Horncastle, Esq.	...	..	...	5·0	...	...	...	...	...	4·0	...
Welbeck Abbey	Mr. Tillery	...	...	13·0	...	...	...	...	...	...	...	...
Derbyshire—Buxton	E. J. Sykes, Esq.	...	...	...	—1·5	...	...	...	...	...	...	..
Lancashire—Holker, Cartmel	Mr. Wilson	...	14·0*	...	...	...	...	...	...	...	...	...
Yorks—High Hazles, Sheffield	Mrs. Hounsfield	20·0	18·0	13·0	16·0	25·0	20·0	21·0	27·0	25·0	17·0	...
Willow Hall, Halifax	Louis J. Crossley, Esq.	...	...	...	...	...	...	...	...	...	10·0*	..
Malton Nurseries	*The Times*	...	11·5	8·0	7·0	20·0	20·0	20·5	19·0	3·0	...	...
,, Town	,,	...	18·0	14·0	13·0	21·0	24·0	25·0	23·0	..	...	...
Beadlam Grange	J. H. Phillips, Esq.	...	..	...	...	...	...	...	...	...	4·0*	...
Hawsker, Whitby	Rev. F. W. Stow	...	19·7	20·5	...	...	...	...	18·5	20·0	9·0	16·5
Middlesboro'	W. Fallows, Esq.	10·0	...	...	...	..	...	...	20·0	7·0	6·0	...
Durham—Stockton	*The Times*	...	5·0	9·0	12·0	...	...	...	...	...	...	..
Westmoreland—Casterton	S. Morris, Esq.	...	...	...	...	...	...	...	...	...	8·5	...
Kendal	R. J. Nelson, Esq.	..	...	...	...	..	...	...	...	...	10·0*	...
Grasmere Rectory	Mr. E. Tucker, Jun.	14·0	14·5	16·0	28·0	17·0	24·0	28·0	27·0	23·0	20·0	26·0
High Close, Loughrigg	E. B. W. Balme, Esq.	21·0	18·0	17·0	18·0	25·0	23·0	24·0	24·0	28·0	23·0	26·0
Wales-Pembroke-Haverfordwst	E. P. Phillips, Esq.	16·0	19·0	17·0	19·3	11·0	17·0	28·0	16·0	1·0	18·0	...
Wales—Glamorgan—Merthyr	T. J. Dyke, Esq.	...	...	13·0	...	...	...	...	...	...	...	...
Denbigh—Trevalyn Hall	B. T. Griffith, Esq.	18·8	15·2	13·5	11·5	21·0	14·0	18·4	27·9	19·6	3·6	9·8
Carnarvon	Major Mathew	20·0	11·0	13·0	14·0	14·0	12·0	15·0	30·0	18·0	9·0*	13·0
Ireland—Galway—Ballinasloe	J. Kempster, Esq.	...	...	...	...	...	...	...	...	...	19·0*	...
Antrim—Carrickfergus	A. Sutherland, Esq.	..	19·0*	..	...	...	...	...	...	...	...	...

* Denotes Minimum of the Period.

To descend, however, from generalities to particulars: in the few pages following, we give lists of temperatures; the responsibility for the accuracy of those observations rests with the authors, but surely a little rests with ourselves. Suppose we printed a letter from, say, Dover declaring that the temperature there had not fallen below 32°; the writer would be responsible for an incorrect statement, but surely we should be blameable for printing that which was obviously erroneous. Hence we arrive at the conclusion that the responsibility of all observations rests with the observers, and that our editorial duty is to exercise a reasonable supervision.

Let us now consider the second prefatory subject, viz., causes of discrepancy, and they are principally threefold—(1) instrumental, (2) position, (3) observational. Instrumental: owing partly to the increased desire of the observers for accuracy, and partly to the reasonable price at which tested thermometers can now be purchased, we believe that most of those used by our correspondents have been tested, and were, therefore, when supplied, correct within a few tenths of a degree. Unfortunately there is no mercurial minimum thermometer yet invented which is available for universal use. Several have been produced, but none is perfectly satisfactory, therefore Rutherford's minimum is still generally employed, and it has one serious disadvantage, to which attention cannot be too often directed; the spirit evaporates, and condenses at the upper end of the tube, leaving the column shorter by the amount so transferred, and, therefore, causes the thermometer to read and register that much too low. Where the spirit is coloured this error is readily noticed, but when it is uncoloured or bleached by exposure it is liable to pass unnoticed. Observers cannot be too careful in watching against this error. Irrespective of the visibility of the fluid at the top of the tube, it is, of course, readily detected by occasional comparison with a mercurial thermometer. In most cases the thermometer can be restored to its original accuracy by swinging it sharply, bulb downwards, and leaving it to stand for an hour or so in that position before re-hanging it horizontally on its ordinary hooks.

Position: by this we do not mean locality, but mode of hanging, variety of stands, influence of walls, and a series of small details on which hitherto no information has been available. Until Mr. Gaster completes his discussion of the Strathfield Turgiss experiments we should be unwise to say very much on this head; but even on what are supposed to be proper stands the variation has been shown* to be 5°. Surely we want no further evidence of the necessity for adopting identical arrangements.

Observational: unless a man was so absurdly thoughtless as to register the position of the *wrong end of the index*, viz., that nearest to, instead of that farthest from, the bulb, we do not see how any systematic mistake could be made in the reading. A serious one was,

* *Meteorological Magazine*, Vol. IV., p. 186.

however, often made in registering, and, in spite of repeated warning in these pages, we fear is still too frequent; we refer to the entry of the temperature to the wrong day. The minimum temperature indicated by the thermometer when read at 9 a.m. is the minimum of that day, and is always to be so entered; too frequently it is spoken of as the cold of the night of the previous day, hence leading to confusion. The following extract from a letter recently received from a careful observer is so apposite, that we are sure that he will excuse our quoting it:—

"A *stringent* rule ought to be issued on authority in regard to other instruments as well as the rain gauge, *e.g.*, when the minimum of the thermometer is noted at 9 a.m., as it should be, the float should not be moved again till the next day at the same hour. I have reason to believe that the notion is not uncommon that the minimum applies to the *night* immediately preceding, not to the previous 24 hours. In winter, especially, the temperature at 9 a.m. on one day is much lower than that of the following night. It might be well to record the *minimum* of each *night*, but that is not done or aimed at under the present system."

A certain number of rules are printed on the back of the forms issued by the Meteorological Society to English observers, and on those supplied by the Scottish Meteorological Society to their observers; others may be picked up elsewhere, but some are contradictory, some confusing, and all are incomplete. What is required is a compact but copious little manual, which should be rigidly obeyed by every one desiring to be considered a regular observer. Doubtless most of us would have to relinquish some pet practice, but we envy not that man's disposition who would prefer continued anarchy rather than that his individual complacency should be disturbed.

Our remarks on modes of observation have run to such a length, that those on the frost itself must be shorter than we had intended. Perhaps as stray observations are still coming in daily we may have to refer to the subject in our next. In either case it will be desirable to add a few remarks to the numerous notes with which we have been favoured, and to the table on pages 202 and 203. In the first place, we may mention that that table does not contain all the minima to be found in this number, as, in order to save space, those at our regular stations are not (with one or two exceptions) repeated. Such of our readers, therefore, as desire to investigate the details of the frost thoroughly, must combine the information on page 217 with that on pages 202 and 203.

The frost seems to have been severely felt first in the South-Western Counties on December 23rd, the temperature at Sidmouth running down to 19°, and at inland stations to 7° or 8°. On 24th it was most severe along a narrow line running N.N.W. from the Isle of Wight. At Newport it fell to 19°.

The 25th was, however, at most stations, in fact at almost all eastern ones, the date of greatest cold; for its general distribution we must refer to the general tables, but as its greatest intensity was in Norfolk, and several returns from that county have reached us since the general tables were printed, we are induced to give in geographical order

(from S. to. N.) the minimum temperatures on Christmas morning in the County of Norfolk :—

Dickleborough, Diss.. ...	0·0	Bethel Street, Norwich ...	+5·5
Shadwell Court, Thetford ...	—3·0	Thorpe ,, ...	+5·0
Stanford Vic., Watton ..	—9·0	Mattishall, Dereham... ...	—3·0
Wereham, Downham ...	+1·9	Dereham	+3·0
Kimberley, Wymondham ...	—6·0	Reepham	—2·0
Carleton, ,, ...	—7·0	Hillington	+4·0

All the above stations at which the temperature fell below zero are within a tract 25 miles long, from S.W. to N.E., and less than 10 miles broad, of which Watton is nearly the centre ; and from the vicinity of Watton comes the lowest reported temperature, this of course is comfirmatory of its accuracy. Again, Kimberley is within two miles of Carleton ; one reports —6·0, the other —7·0 ; this again is satisfactory.

Without a thaw, the temperature rose from this depression, but on the 31st December, and 1st January, it again fell considerably, and remarkably low temperatures are reported from South Wales.

Our readers will notice two returns from Grasmere, which are interesting, as showing the influence of altitude, Grasmere Rectory is only 219 ft. above sea level, while High Close is 553 ft., the temperature at the higher station being always the warmer.

To the Editor of the Meteorological Magazine.

SIR,—Doubtless you will receive many communications with respect to the late very severe cold weather, and in order that you may be able to compare the temperature of the south coast with that of London and other places, I beg to forward you my memoranda from Dec. 21st, 1870, to Jan. 2nd, 1871. Thermometers at 4 ft. from ground :—

Date.	Temp. at 9 a.m.	Max. in air.	Min. in. air.	Min. on grass.
Dec. 21 ...	30·7 ...	31·5 ...	30·3 ...	30·2
,, 22 ...	25·5 ...	27·0 ...	24·0 ...	22·1
,, 23 ...	21·7 ...	28·0 ...	19·4 ..	16·0
,, 24 ...	32·5 ...	33·5 ...	21·2 ...	15·5
,, 25 ...	23·0 ...	29·7 ...	21·1 ...	18·3
,, 26 ...	29·9 ..	33·2 ...	23·4 ...	21·1
,, 27 ...	27·5 ...	29·7 ...	23·4 ...	12·6
,, 28 ...	29·1 ...	31·7 ...	23·6 ..	21·8
,, 29 ...	29·2 ...	31·2 ...	26·3 ...	17·4
,, 30 ...	21·2 ...	28·1 ...	18·9 ..	11·4
,, 31 ...	21·8 ...	28·3 ...	19·9 ...	16·5
1871. Jan. 1 ...	23·9 ...	32·2 ...	20·9 ...	16·2
,, 2 ...	27·8 ...	29·2 ...	23·6 ...	21·9

From the above you will perceive that the morning of Dec. 30th was the coldest registered here.

I find that in the frost of December, 1855, the extreme in shade was 17°·5 ; in December, 1860, 17°·9 ; and January, 1867, 18°. These latter figures I have taken from the Registrar-General's reports, as supplied by the late Dr. Barker.

My thermometers are all certified ones, and are situated 21 ft. above sea level.—Yours obediently, W. J. HARRIS, F.M.S.

Worthing, Jan. 3rd, 1871.

To the Editor of the Meteorological Magazine.

SIR,—We have just passed through a period of such unusually low temperatures that I send you a few extracts from my diary, in case you can find a corner for them in your next number of the *Meteorological Magazine*.

Date.	Max.	Min.	Min. on grass.
1870, Dec. 21	30·2	29·6	26·5
,, 22	25·8	20·5	14·0
,, 23	25·8	11·2	11·8
,, 24	25·4	7·4	10·0
,, 25	26·0	4·0	10·0
,, 26	33·5	6·4	9·8
,, 27	29·4	10·7	9·0
,, 28	32·4	20·5	22·8
,, 29	33·3	23·1	15·3
,, 30	26·9	6·3	2·8
,, 31	26·3	4·0	—2·7
1871, Jan. 1	29·3	2·7	—2·2
,, 2	26·8	6·4	25·2
,, 3	35·8	23·3	24·2
,, 4	35·9	28·3	27·3
,, 5	41·8	5·0	8·0

This is the coldest wave of polar current we have experienced in this neighbourhood since the 3rd of January, 1867, when the minimum on grass was—3°·0.

The cold has caused the formation of very thick ice. In the Loddon, ice 7 inches thick has accumulated around the bay in which my registration thermometers are placed, and it is so solid that as yet it is impossible to get at them, even with pickaxe and lever. In the evaporation tank the ice is now 9 inches thick; at one time I feared the entire mass of water would freeze, to the destruction of all the thermometers therein..

The poor birds have had a bad time of it, several having been found here frozen to death, whilst the wild ducks, unable to procure food in their own natural element, have ventured, with singular boldness, to our parks and homesteads. Many a poor mole, too, I have found stark and dead just beneath the snow, having ventured out in some less frozen or sun warmed corner, and after working his way in a curiously marked meandering course over the snow in the endeavour to re-enter the bosom of mother earth, has, at last, been obliged to succumb, and been frozen to death.

Roots and sheep-keep have been much damaged and rendered inaccessible by the intense frost, so that the attacks on our small hay-stacks have been so formidable as to give rise to apprehensions of failure of supply, or, at least, of great increase of price before we can cut hay again. There has, however, been sufficient snow to protect the wheat plants.—Yours, &c.

CHAS. H. GRIFFITH.

Strathfield Turgiss, January, 1871.

To the Editor of the Meteorological Magazine.

DATE.	Thermometer.			Rainfall.		Wind.	Thermometer.					Ther. at Hillington Hall Gardens.
							a.m.			p.m.		
	Min.	Max.	Mean.	rain	snow		9,	12	3,	7,	11	Min.
	deg.	deg.	deg.	in.	in.		deg.			deg.		deg.
Friday 23	12	30	21·0	...	5·0	N.	20,	28	...	...	...	+5
Saturday 24	4	23	13·5	·09	...	S.W.	9,	...	...	...	...	—5
Sunday 25	5	33	19·0	...	3·0	S.W., N.E.	7,	13	16	...	31	...
Monday 26	28	37	32·5	...	...	N.E.	35,	31	31	...	32	+6
Tuesday 27	20	33	27·5	...	4·0	N.E.	20,	...	30	32	32	...
Wednes. 28	14	36	25·0	·04	3·5	E.N.E.	28,	...	34	32	33	...
Thursday 29	29	35	32·0	·20	5·5	N.E.	31,	33	...	29	27	...
Friday 30	11	29	20·0	·09	7·0	N.E.	13,	...	26	15	28	...
Saturday 31	9	35	22·0	...	...	N.E.	30,	32	...	12	3	...
Sun., Jan. 1	3	27	15·0	...	...	S.E.	25,	26	..	13	25	—1
Monday 2	11	...	...	...	..	S.E.	27,	..	...	..	..	...

It should be remarked that at the Hall gardens the thermometer always is lower than at the Rectory. The situation is lower, and near water; but this will not account alone for the great difference. The Hall thermometer is completely exposed: mine is in a wooden case, like one of those represented in a former number of your *Meteorological Magazine*. It stands quite in the open and unsheltered; a free current of air passes through, but wet and wind cannot find an entrance. But is not the plan of affixing a thermometer to an exposed wall (for minimum purposes) or on a piece of bare board, after all, the most correct index of the cold?

H. FFOLKES.

Hillington Rectory, Lynn.

To the Editor of the Meteorological Magazine.

SIR,—Thinking many of your subscribers would be sending you their temperature readings during the late severe frost, I enclose mine.

Dec.		Max.		Min.
21	...	35·8	...	34·6
22	...	26·6	...	22·8
23	...	32·6	...	19·4
24	...	36·2	...	21·2
25	...	33·4	...	22·4
26	...	36·2	...	22·7
27	...	32·3	...	25·3
28	...	33·3	...	25·3
29	...	33·1	...	29·0
30	...	31·8	...	25·5
31	...	36·6	...	21·2

Lowest temp. 19°·4, on 23rd; highest, 54°·8, on 14th. Wind chiefly N., N.E., and E. Adopted mean temp. of month, 35°·7, or 8°·5 below average of last 5 years (1865—69); daily range, 9°·5.

J. INGLEBY-MACKENZIE, M.B., F.M.S.

Sidmouth.

To the Editor of the Meteorological Magazine.

SIR,—The frost which set in on St. Thomas's day has proved the most severe that I have had to record since I first began to keep a

record of the weather, fifteen years ago. The following figures taken from my diary will serve for comparison with those of other observers.

1870.	Max.	Min.	Range.	Mean.
Dec. 21	29·1 ...	27·8 ...	1·3 ...	28·4
,, 22	25·7 ...	19·5 .	6·2 ...	22·6
,, 23	26·0 ...	13·7 ...	12·3 ...	19·9
,, 24	24·6 ...	12·9 ...	11·7 ...	18·7
,, 25	28·8 ...	9·3 ...	19·5 ...	19·1
,, 26	33·4 ...	12·3 ...	21·1 ...	22·8
,, 27	28·6 ...	14·7 ...	13·9 ...	21·7
,, 28	32·2 ...	18·4 ...	13·8 ...	25·3
,, 29	32·8 ...	23·6 ...	9·2 ...	28·2
,, 30	26·6 ...	18·0 ...	8·6 ..	22·3
,, 31	20·3 ...	7·2 ...	13·1 ...	13·7
Means	28·0	16·1	11·9	22·1

The monthly mean from December, 1870, here, was 31°·6, being the coldest December I have yet recorded. —Yours, &c.,

JOHN THRUSTANS, F.M.S.

Merridale, Wolverhampton.

P.S. The minimum temp. this morning, January 1, was 4°·9.

To the Editor of the Meteorological Magazine.

SIR,—The minimum temperature attained here during the present frost was 13°·3, on the morning of 24th. On Christmas morning, 1860, my thermometer registered 10°·4, the lowest during 25 years (1846-1870).—Faithfully yours, C. S. BARTER, M.B.

27, *Paragon, Bath, 29th December*, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The following are the readings of the maximum and minimum thermometers in the shade, 4 ft. above the ground, at Bucknall, Lincolnshire, from 21st to the end of December :—

Date.	Max.	Min.	Date.	Max.	Min.
21 ...	30·5 ...	29·5	27 ...	31·5 ...	23·0
22 ...	28·5 ...	21·5	28 ...	34·0 ...	23·0
23 ...	21·5 ...	14·5	29 ...	34·0 ...	29·0
24 ...	18·0 ...	2·0	30 ...	30·0 ...	21·0
25 ...	26·0 ...	5·0	31 ...	20·5 ...	11·0
26 ...	32·0 ...	21·0			

The mean temps. on the 23rd, 24th, and 25th, were respectively below the average, —21·8, —29·6, and —24·3. On the 26th the mean temp. rose 11 degrees.

My thermometers are by Casella, and have been verified at Kew.

Yours, &c., W. CARTER.

Bucknall, Horncastle.

To the Editor of the Meteorological Magazine.

SIR,—The 1st of this month was the coldest day I recollect. The maximum thermometer in shade was 21°, and there was a most bitter south wind. The minimum was 12°, the lowest for nearly ten years.

Yours, &c., T. W. BACKHOUSE.

West Hendon House, Sunderland,
January 6th, 1871.

To the Editor of the Meteorological Magazine.

SIR,—Absence from home has alone prevented me sending you at an earlier date the following notes as to the temperature at this place. Lat. 54° 32′ N.; Long. 1° 44′ W. Altitude, 251·8 ft. Observations taken daily at 9 a.m.

Date.	Min.	Date.	Min.	Date.	Min.	Date.	Min.
Oct. 11...	28·9	Nov. 15...	23·0	Nov. 29...	28·5	Dec. 17...	20·5
,, 15 ..	28·5	,, 16...	28·0	,, 30...	27·0	,, 18..	27·0
,, 27...	29·5	,, 17...	23·0	Dec. 1...	30·0	,, 21...	26·5
Nov. 2...	25·0	,, 18...	25·0	,, 2...	26·0	,, 22...	16·0
,, 3...	28·0	,, 19...	23·7	,, 3...	29·0	,, 23...	7·5
,, 7...	27·5	,, 20...	28·0	,, 7...	28·0	,, 24...	0·5*
,, 8...	26·5	,, 21...	32·0	,, 8...	23·0	,, 25...	14·5
,, 9...	25·0	,, 22...	29·5	,, 9 ..	24·0	,, 26...	21·0
,, 10...	27·0	,, 23...	31·0	,, 10...	31·0	,, 27...	14·0
,, 11 ..	29·0	,, 26...	27·5	,, 12...	29·0	,, 28...	11·0
,, 12...	27·5	,, 27..	31·0	,, 14...	25·0	,, 29...	18·5
,, 13 .	28·5	,, 28...	26·0	,, 16...	24·0	,, 30...	20·0
,, 14...	28·0						

* ½° above zero.

I left home on the 30th, and wrote to a friend to take the readings, and he could not do so until Jan. 2, when he found the register marked 3° below zero, and I have no doubt this indicated the night of the 30th-31st, as the same evening the thermometer at Middlesboro'-on-Tees was at 11 p.m. 1° above zero.

Jan. 3.....	17·0	Jan. 6.....	30·0
,, 4... ..	8·0	,, 7.....	33·0
,, 5.....	7·0	,, 8.....	25·0

If you find any of these memoranda useful for the "Magazine" I shall be glad.—Yours, truly,

A. ATKINSON.

Gainford, near Darlington, Jan. 7th, 1871.

To the Editor of the Meteorological Magazine.

SIR,—The frost which set in on December 21st, has been very severe in this district. I send you the minimum temperatures recorded here daily up to the present date by Casella's self-registering thermometer, suspended on a wooden stand on the "Glaisher" principle. The stand is fixed at some yards' distance from the house on the N.E. side, and the thermometer bulbs are 4 feet above the ground.

Dec. 21...	30·0 deg.	.....	Dec. 28...	18·4 deg.	
,, 22...	18·8 ,,	.....	,, 29 ..	27·9	,,
,, 23...	15·2 ,,	.....	,, 30...	19·6	,,
,, 24...	13·5 ,,	.....	,, 31...	3·6	,,
,, 25...	11·5 ,,	.....	Jan. 1 ..	9·8	,,
,, 26...	21·0 ,,	.....	,, 2 ...	25·5	,,
,, 27...	14·0 ,,	.....			

The extraordinarily low minimum of the 31st December is the lowest temperature experienced here for 10 years, viz., since December 25th, 1860, when 3°·3 was recorded. The maximum in shade on the 31st was only 20°. Snow has fallen at intervals to the total depth of

about 2·1 inches. The eclipse of the sun on December 22nd was very favourably seen here, the sky being nearly free from cloud at the time.

Yours faithfully,

BOSCAWEN T. GRIFFITH.

Trevalyn Hall, Wrexham, Denbighshire, Jan. 2nd, 1871.

To the Editor of the Meteorological Magazine.

SIR,—I enclose you a statement of the temperature experienced here during the late severe frost. One of the thermometers, (a minimum one), being placed in the shade, five feet above the ground, and not by a wall; the other (a minimum one) placed on the grass at night, three fingers above the ground. The daily maximum and minimum I have very accurately observed myself. I have sent this, hearing you were desirous of collecting facts connected with this particular frost.—

Yours truly, E. TUCKER, JUN.

The Rectory, Grasmere, Jan. 9th.

Date.	8 a.m.	Max.	Min. in air.	Min. on grass.
1870, Dec. 20	42·0	43·0	30·0	28·0
,, 21	30·0	32·0	23·0	18·0
,, 22	26·0	29·0	14·0	9·0
,, 23	14·0	26·0	14·5	11·0
,, 24	18·0	24·0	16·0	9·0
,, 25	18·5	31·0	28·0	26·0
,, 26	33·0	36·0	17·0	14·0
,, 27	24·0	35·0	24·0	19·0
,, 28	29·5	33·0	28·0	25·0
,, 29	30·0	33·0	27·0	21·0
,, 30	29·0	33·5	23·0	19·0
,, 31	25·0	26·5	20·0	17·0
1871, Jan. 1	22·0	29·0	26·0	25·0
,, 2	27·0	28·5	26·5	25·0
,, 3	27·0	32·0	9·0	5·0
,, 4	9·0	28 5	28·0	27·0
,, 5	38·0	42·0	36·0	32·0

OZONE OBSERVATIONS.

To the Editor of the Meteorological Magazine.

SIR,—I do not think the remarks made by Mr. Chichester in your December number on this subject should be allowed to pass unnoticed, as they are so completely at variance with the spirit and principles of scientific investigation. That for many years ozone observations have been taken with scrupulous care by eminent meteorologists, and with ordinary care by thousands of observers, is well known. It is also equally well known that the number of facts thus elicited, and the progress made in connecting the phenomena in the way of causation have not been quite so satisfactory as was anticipated. Several able observers have devoted their time to the discussion of extensive series of results, and all, I believe, are agreed that upon the whole the present method of observation is sufficiently good for those who have but limited time. Indeed, the mere fact that 9 a.m. readings are thought worth tabulating and recording by Mr. Glaisher should have been,

one would think, a sufficient guarantee to Mr. Chichester that in adopting such a course he would not be altogether wasting his time, or, at any rate, that he would not be the victim of a wide-spread delusion and snare. But to come to the facts. This observer made up his mind to "go in" for ozone—*i.e.*, he seriously resolved to do what in him lay to help on this interesting investigation. In a very short time Mr. Chichester, like every other ozone observer who has taken readings for a fortnight in spring, autumn, or winter, discovered some curious effects, but, unlike other observers, he was so astonished and disheartened by them that he at once threw up the investigation and unhesitatingly pronounced it a "delusion and a snare." The observed effects were these :—Putting out his paper at 9 a.m., he saw it was untinted, but on looking at noon it was darkened. Now this was most interesting and stimulating to Mr. Chichester, as it would be to any true observer of natural agents and their effects. On examining his paper at 3 p.m. its discolouration was complete. Here, then, was another and still more stimulating phenomenon, and I do not envy the natural philosopher who could witness such phenomena as these and resist their charm ; but, with a true instinct, Mr. Chichester noted the fact that between noon and 3 p.m. "rain and wind" had come. Here, then, were simultaneous effects occurring. What was their relation? were they links in a chain of phenomena? were they bound together by a law of causation? Surely these questions presented themselves to the observer and made him resolve that, if possible, he would find an answer. Surely he at once began to observe his papers every twelve hours, or every six hours, or even, engagements permitting, every three hours. Not so : because the 9 a.m. readings did not tell him exactly all the infinite conditions of the passing aerial tide during the previous 24 hours, he abruptly closes the series, declares himself to have been shamefully deceived, and makes a vigorous resolution that he will never again "bother himself" about ozone.

But Mr. Chichester finds much comfort in learning that he has a fellow victim. He finds that Mr. Thrustans also has suffered and come to the *same* conclusion as himself. Now I do not find this. I find that Mr. Thrustans on discovering the insufficiency of 9 a.m. readings tried morning and evening observations. What better plan could any observer have adopted? and I shall not be surprised to learn that this gentleman, if time allows, will soon try six-hourly readings.

It is precisely these surprises and disappointments, which constantly meet the patient investigator of natural phenomena, that impart such interest to his labours, and stimulate him in the pursuit. The methods are varied; simultaneous series or successions of phenomena reveal themselves ; he watches their combined, and, if possible, their separate effects ; he changes or increases his hours of observation ; and thus he is enabled to eliminate all that is not relevant, and, finally, to seize the simple or combined causes of the effect or effects produced.

Yours truly,

JOSEPH GLEDHILL, F.G.S., F.M.S.

Park Road Observatory, Halifax.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—I am obliged to Mr. Stow for his comments on my letter in the "Magazine," but I think he is a little premature in soothing himself with the great perfection attained by the thermometers "*in vacuo*" of Messrs. Casella, and Negretti, for he seems quite to forget the fact, which I before pointed out, that my two Casella thermometers, B and C, though both are blackened on the bulbs and part of the stems, had a *mean* difference of 3°, and occasionally varied from one another by 6°, B however having the larger bulb (according to Mr. Stow himself) the difference from that cause alone should have been the *reverse* way.

Surely this difference must arise in a great measure from imperfect exhaustion of the jackets, and we now know what that means, viz., low temperatures. Not that I at all wish to blame any of the manufacturers for carelessness in the troublesome process of exhaustion: quite the contrary, I think that most of these instruments, from what I have seen, are models of sensitiveness and finished workmanship.

Mr. Stow, I presume in a somewhat satirical vein, talks about my "conjuring up a ghost;" if he refers to the large mean difference of 15°·4 between Pastorelli's thermometer (A) and that of Casella (B), as the said ghost (if ghost at all), it must be a decidedly tangible one! but not of my "conjuring up," since we have found it haunting the instruments of both those eminent makers, Messrs. Casella and Pastorelli. If, however, I have assisted in any measure in laying this "ghost," as Mr. Stow terms it, I shall have been fully repaid for the work I have already had on "Solar Radiation Temperatures."

Yours very truly,

FRANCIS NUNES, M.A., F.M.S.

Heathfield Lodge, Chislehurst, Kent, Dec. 23rd.

P.S. With regard to the subject of thermometers with *unexhausted* jackets, as far as I can judge from my experiments up to the present time, I confess I am favourably impressed with their working.

To the Editor of the Meteorological Magazine.

SIR,—My attention has been directed to an article by Mr. F. W. Stow in your Magazine of this month in explanation of the different indications given by some solar thermometers made for Mr. Nunes.

Mr. Stow explains this difference as owing to an indifferent vacuum in the thermometer A, supposing that by some unfortunate accident air had found admission during the process of manufacture. With respect to this explanation, I can only say that both thermometers supplied to Mr. Nunes were made under my supervision with the greatest care. If air has found admission into A with the attention bestowed upon it in the manufacture, it must indeed be owing to an extraordinary accident. But I recollect that other solar thermometers

of similar construction have recorded equal and even greater differences. Mr. Stow himself says, in Vol. III. of your Magazine, page 149, of the sources of discrepancy between solar thermometers :—"The first, though immense between thermometers *in vacuo* and ordinary black bulbs, will seldom exceed 10° between well-made thermometers *in vacuo*; I have indeed in one instance found 14°."

Even your experiments cited in the same volume, page 114, gave these results :—

"5. Compared them all lying near together on a rather burnt-up grass plot; found differences amounting to 10°, and variable, sometimes A was lowest, sometimes B, and so on."

I have no doubt, if your space would allow of it, I could cite other cases of similar observed differences, but I believe these to be sufficient to make the above explanation less probable than it would be if the observed difference in the indications by the two thermometers of Mr. Nunes were a solitary case, else we have to suppose it is rather a common case for air to find admission into solar thermometers in the final process of exhaustion; this, however, is not very probable, as Mr. Stow assures us in his last letter that Mr. Casella guarantees all those instruments that he makes to be within three-quarters per cent. of an absolute vacuum; now the thermometers used in your experiments were made by Mr. Casella, I am therefore inclined to believe that there most be other causes besides which produce this discrepancy. I therefore intend to ask Mr. Nunes for the return of the supposed faulty thermometer, in order to find out the cause of the difference. If I should succeed in this, I will inform you of the results.

Perhaps there may be a difference in the absorbing power of the various lamp black.—Yours truly,

F. PASTORELLI.

208, *Piccadilly.*

DIFFERENCE BETWEEN READINGS OF MERCURIAL AND ANEROID BAROMETERS.

To the Editor of the Meteorological Magazine.

SIR,—Your correspondent, Mr. J. Knox, bases his comments on the difference between readings of his mercurial and aneroid barometers on what seems to me to be mere assumption. Apparently he is not aware that the aneroid is an instrument peculiarly susceptible to changes of temperature, even when said to be "compensated" for temperature. Accordingly the differences found by him are easily accounted for on the very safe supposition that his aneroid is either not at all, or very badly, compensated. Thus the mean difference, in August of +·021 may be set down against mean temperature 63°; that in September, +·012, against 58°; and that in October, −·014, against 51°. The temperatures quoted are mean values for London; they may have been different for the particular time and place, but that will not affect the

explanation. The aneroid was evidently reading too high in 63°, and too low in 51°, in accordance with the usual behaviour of aneroids, which have good vacuums, but are not compensated. The idea of such variations of the indications of pressure predicting coming changes of weather is rather absurd. Mr. Knox should state whether or not his aneroid is compensated for temperature. At a future time I may offer a short explanation of the theory of compensation for this very practically useful, but in a scientific point of view rather uncertain instrument. Yours truly,

R. STRACHAN.

11, *Offord Road, London, N., 30th November*, 1870.

P.S. As none of your reports of the aurora of October 24th, 1870, speak of its appearance so late as 11 p.m., it may be interesting to describe what I witnessed at that time. I had not seen it earlier, and my attention was then drawn to it by the crimson glare, as from a fire, visible through a window facing north. From the roof of the house I got a fine view. The stars were very bright and numerous, the sky being intensely blue. A dull grey arch of cloud seemed to extend about 15 degrees above the horizon, at the magnetic north, which was the radiant point of the display. From this arch at N.W. by N. and at N.E. by N. (by compass) two broad bands of crimson streamers extended to about 60 degrees above the horizon. The stars were visible through the streamers, and no other colours were noticed. I did not watch it for more than ten minutes.

THE WINTER.

To the Editor of the Meteorological Magazine.

SIR,—The mean temperature of December, 1870, at the Royal Observatory, Greenwich, was 33°·6, which is 6°·1 below Mr. Glaisher's adopted average of 50 years, and 5°·5 below the average of 99 years.

A clerical error occurred in Table I. of my last letter. Instead of January to March, 1771, it should be January to March, 1772. If your readers will kindly alter 1771 to 1772, the table will be correct.

I am, &c.,

GEORGE D. BRUMHAM.

Barnsbury, January, 1871.

METEOROLOGY IN THE UNITED STATES.

The United States' Government commenced on the 1st of November the publication of a daily record of the state of the weather in various parts of that country. In so vast a territory the variations are great. On the first day the thermometer did not exceed 51 deg. at Boston, but reached 75 deg. at Omaha, 80 deg. at Lake City, Florida. The pressure of the wind was ·02lb. per square foot at Nashville, Tennessee; ·08lb. at New York and some other places; 3lb. at Cheyenne, Omaha, and Pittsburg, Pennsylvania.—*The Times.*

THE SOLAR ECLIPSE.

To the Editor of the Meteorological Magazine.

SIR,—I hoped to have sent you a report on the influence of the eclipse on thermometers in sun and shade; but as none of my regular correspondents appear to have taken any observations, with the exception of yourself and Mr. Leighton Kesteven, I had better defer it, in the hope of obtaining some. May I beg your readers to send me a copy of any observations taken, stating the thermometers used, and how placed?

I am, &c., F. W. STOW.

Hawsker, Whitby.

[We have been favoured with some notes on the above by the Rev. Hugh Ingram, of Steyning, Sussex, and Dr. Radford, of Sidmouth, and we think that the best plan will be to defer their insertion till our next, so that the subject may then be completely considered.—ED.]

REVIEW.

Quarterly Report of the Meteorological Office (Published by authority of the Meteorological Committee), *Part II., April—June*, 1869. London: Stanford, 4to., 60 pages, 36 plates.

This second issue of the fac-simile records of the seven observatories is evidently equal in accuracy to the first part, which was fully noticed in these columns. The only difference in the two numbers is in the *partial* adoption of a suggestion in one of our notices of the first part. The paragraph ran as follows:—

"We regret that it did not occur to the Committee to instruct some scale-maker to prepare a number of such time-scales upon horn (like those in Piddington's and other works on the wind), and supply one in a pocket with each copy; a large number being required, their accuracy would have been as much greater as their cost would have been less, than that which each separate student of the curves is now compelled to incur."

In the part now under notice, four extra copies of the scales are given, so that they may be cut out and used in measuring the curves. We at first thought that paper had been substituted for horn in order to secure extreme accuracy. Paper varying in its dimensions under the different processes of printing might not agree *precisely* with the horn scales, but similar paper, similarly treated, agrees very closely. On examination it appears that the spare curves are on different paper from that used for the rest of the plates, hence this cannot have been the reason, and while accepting the partial adoption of our suggestion as a proof of its soundness, we adhere to the opinion that, all things considered, horn is the proper material.

The daily journal possesses its usual completeness, and the curves are as clearly printed as in the previous number—we could not award higher praise.

DECEMBER, 1870.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·07	+ 1·57	·55	15	18	57·2	14	14·0	25	19	23
II.		Maidstone (Linton Park)	3·68	+ 1·85	·66	14	22	59·0	14	13·0	24	22	...
,,		Selborne (The Wakes)	3·29	+ ·54	·81	13	15	53·0	14	5·0	25	24	24
III.		Hitchen	2·60	+ 1·29	·40	13	19	55·0	14	5·0	30	21	...
,,		Banbury	2·20	+ ·53	·63	13	17	55·0	14	6·0	25	25	...
IV.		Bury St. Edmunds (Culford)	4·01	+ 2·52	1·16	19	23	56·0	14	1·0	25	19	26
V.		Bridport	3·84	+ ·47	·91	16	13	54·0	13†	14·0	23‖	20	...
,,		Barnstaple	2·42	— ·70	·43	17	12	58·5	14	15·0	31	17	...
,,		Bodmin	3·70	— 1·54	·64	13	17	53·0	13	15·0	31	12	16
VI.		Cirencester	2·20	— ·09	·77	13	10	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	2·41	+ ·73	·82	19	14	53·0	14	7·0	25	23	...
,,		Tenbury (Orleton)	2·01	— ·45	·46	13	20	56·8	14	4·5	31	20	25
VII.		Leicester (Wigston)	2·72	+ 1·20	·73	20	11	55·0	14	9·0	23·*	22	...
,,		Boston	3·86	+ 2·37	1·07	19	24	56·0	14	9·0	31	15	24
,,		Grimsby (Killingholme)	4·15	..	·79	8	22	55·0	14	9·5	24	14	...
,,		Derby	2·07	+ ·52	·49	13	17	56·0	14	9·0	25	18	...
VIII.		Manchester	2·53	+ ·20	..	...	...	..	..	...	...	..	..
IX.		York	3·16	+ 1·36	·51	13	19	51·5	20	11·0	31	16	...
,,		Skipton (Arncliffe)	4·23	— ·32	1·06	9	14	47·0	15	4·0	31	23	...
X.		North Shields	5·21	+ 3.01	·73	6	26	54·0	19	13·3	23	15	20
,,		Borrowdale (Seathwaite)	6·50	—10·45	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·62	— 2·21	·72	14	8	54·0	13	1·0	30	22	27
,,		Rhayader (Cefnfaes)	2·46	— ·83	1·00	13*	9	53·0	...	5·0	31	17	...
,,		Llandudno	3·21	+ 1·01	·81	19	14	54·7	14	19·2	23	17	...
XII.	SCOTLAND.	Dumfries	1·95	— 1·51	·70	12	9	52·0	19	12·5	24	18	...
,,		Hawick (Silverbut Hall)	1·64	...	·27	14	15	...	...	0·0	23	...	...
XIV.		Ayr (Auchendrane House)	2·05	— 1·97	·68	18	8	50·0	14‡	9·0	26	19	22
XV.		Castle Toward	4·19	— 1·16	1·26	14	12	51·0	19	17·0	22	21	27
XVI.		Leven (Nookton)	3·40	+ ·62	·66	14	20	47·0	18§	6·0	23	21	26
,,		Stirling (Deanston)	2·87	— 1·33	·92	14	16	51·3	19	4·5	23	26	28
,,		Logierait	2·70	...	·63	8	11	...	...	...	...	...	...
XVII.		Ballater	5·02	...	1·40	8	10	47·0	19	—0·5	23	24	..
,,		Aberdeen	5·40	...	1·35	19	18	47·0	19	11·2	27	17	27
XVIII		Inverness (Culloden)	2·88	...	1·16	19	19	47·6	18	21·7	28	18	28
,,		Portree	6·21	— 9·42	1·63	31	13	...	...	...	...	...	...
,,		Loch Broom	4·88	...	1·96	17	17	...	...	...	...	...	...
XIX.		Helmsdale	5·82	...	1·13	14	24	...	...	...	...	...	...
,,		Sandwick	5·52	+ 1·55	·72	14	22	46·0	4	19·0	27	16	24
XX.	IRELAND.	Cork	3·98	...	1·78	11	7	...	...	...	...	...	...
,,		Waterford	2·42	— 2·00	·66	13	13	52·0	14	23·0	9	14	...
,,		Killaloe	3·00	— ·49	·90	11	8	...	...	...	...	...	...
XXI.		Portarlington	1·93	— 1 27	·53	14	18	51·5	18	12·0	9	20	...
,,		Monkstown	2·61	— ·01	·69	13	16	...	...	...	...	...	...
XXII		Galway	3·65	...	1·02	18	13	49·0	5	21·0	9, 27	17	...
,,		Bunninadden (Doo Castle)	3·41	...	·72	13	13	42·0	5††	13·0	25	22	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	2·42	...	·57	11	13	52·0	14	6·0	23	18	27
,,		Strabane (Leckpatrick)	3·42	..	·69	11	13	50·0	18§	10·0	30	26	30

*And 18. †And 14. ‡And 18, 19. §And 19. ‖And 24, 31. **And 24. ††And 9, 20.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON DECEMBER.

ABBREVIATIONS.—Bar for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail, S for Snow.

ENGLAND.

LINTON PARK.—An unsually severe wintry month; rather deep S on ground from 8th to 13th, and again from 21st to the end. Frost very sharp on 23rd, 24th, 25th and 31st; winds mostly from the N. and N.E, but never very high. Bar. low on the 14th, with heavy R that day; ther. lower than for 20 years excepting 1853, 1854, 1855 and 1867, at the same time it was higher on the 14th than usual for December, being 59°.

SELBORNE.—The coldest December I have ever recorded and November the same. In these two months ther. below freezing (on grass) on 43 days; prevailing winds N. and N.E. the first week the middle S.W. and the latter end N.E.; on the 3rd ther. was highest at 7 p.m.; dense fog on 11th and 16th; fog on 12th; min. 31·8; at noon R, then sudden rise to 48·5; 22nd heavy S early morning; very fine after the eclipse 30th. S now 4 in. deep.

BANBURY.—Max. temp. below 32 on 9 days; aurora on 17th.

CULFORD.—From the 12th to the 14th the weather was comparatively mild; the remainder of the month has been excessively cold; in fact the coldest December during the last 12 years; the 24th was also the coldest day we have experienced during that time; the max. temp. being 22° and the min. 1°, making the mean 11°.5. On the same day in 1860 (the 24th) the max. temp. was 28° and the min. —3·0, or 3 degrees below zero, which give a mean of 12°.5. The mean temp. of the whole month was 30° 92.

BRIDPORT.—Of the total rainfall (3·84) 3·44 fell in six successive days from the 11th to the 16th inclusive; S fell to the depth of 1¾ inches on the 27th; good skating on the 10th, and also from the 23rd to the end of the month. On the 31st the min. temp. was as low as 14° early in the evening, but rose to 25 by 11 p.m.; and a slight thaw with a southerly wind on the 1st January. Eclipse of the sun on 22nd seen to great advantage.

BODMIN.—Average temp. of the month 35 3. On the 26th S fell in 4 hours to the depth of 4·70 inches, and formed one-thirteenth that depth of water when melted.

SHIFNAL.—An unusually cold December. For although the rainfall was in excess of average, and on one day the 19th, ·82 in, the temp. was below 32° on 23 nights; on that of 24th it sank to 7°; the severest frost since the same night of 1860. 3 inches of S fell on the 9th and 1 inch on 21st, and again on 28th. No high winds and the prevailing ones from N.W. and N.E. interchangably; great quantites of hips and haws; scarcely any holly berries. By the end of the month the wood-pigeons and plovers, which have been in such flocks, quite deserted us.

ORLETON.—Cold and cloudy with frequent frost; a little S and much fog till the 12th, then warm and rainy till the 16th filling the rivers; S again and cold from the 20th to the end of the month, with much fog and rime; all the rivers frozen over on the morning of the 31st; temp. fell to 4°.5 in the shade to 0° on the grass plot; and the max. was only 17°. Remarkably cold month, nearly 9° below the average. Bar. very high on 1st and very low on 14th; great winds on 12th and 14th; aurora on 17th. Eclipse well seen.

WIGSTON.—The remarkable feature in the month has been that the mean of the max. temp. during the [? last] eleven days of the month was only 27°·3. S fell nearly continuously for 24 hours on the 9th; about 4 inches deep on the level.

KILLINGHOLME.—The last 10 days more severe than any we have had since 1860. Surely Mr. Brumham must be enrolled amongst the prophets. Lunar coronæ on 6th, and 11th. Cock crowing at 11 p.m. on 6th; high wind at night from W. on 18th.

DERBY.—December has been an unusaully severe month, being 2°·5 below the mean of seven consecutive years. On Christmas Eve the temp. fell to 9°, being the lowest reading recorded since Christmas Eve, 1860, when it fell to 2°.

Although the present frost is more sustained in its rigour than that of 1860, yet the destruction of shrubs and trees cannot be so serious, as the frost of that year, unlike this, came on suddenly preceded by a late and genial autumn, which provoked the growth without maturing the young wood. The rainfall of the year is 7·14 inches below a 21 years' mean.

YORK.—Solar halo at 12 a.m. on 16th; mock sun at 12.30 a.m. and aurora at 8 to 9 p.m. on 17th. S continually from 21st to 31st.

NORTH SHIELDS.—Auroræ on 15th, 16th and 17th; T on 21st; solar halo on 23rd; T and L on 25th.

WALES.

HAVERFORDWEST.—A very severe month; the coldest December in my register of 24 years. S fell in small quantities twice, covering the ground to the depth of 2 in. on the level; R fell in considerable quantities during the month; the wind was generally from the N.E. and E.S.E.; a great number of bright days with clear frost; the frost was most severe, even on the sea coast, the S lying close to the high water level, and the icicles hanging from the cliffs resembled the interior of stalactite caverns; they were of enormous size and length. Min. in air 1°, on snow —6°.

CEFNFAES.—A cold, foggy month; wind generally N.E; temp. low, and nights frosty; some days of bright sunshine.

LLANDUDNO. Fog at 4 p.m. on 8th; two peals of T at 2 p.m. on 12th; 22nd, fine but frosty; eclipse well seen.

SCOTLAND.

DUMFRIES.—The first week of the month was mild and fine, the middle stormy and wet; from 21st to close, weather very severe; frost intense, with S on several days 2 to 4 in. deep; mean temp. for the month 34°·5; rainfall 1·93 in. below the average of five preceding years.

HAWICK.—Very stormy on the 8th and 14th; temp. at zero on the night of 23rd; since the 20th the ground has had a covering of 4 in. of S, and the ponds nd streams a thick sheeting of ice.

AUCHENDRANE.—With a great increase in the number of icy days and polar winds, and with a mean temp. greatly below that of the mean of December, and with the low capacity of the air for vapour not fully saturated, the bar. and bar. range were not much below their mean, while the rainfall and evaporation, force of wind and amount of cloud, were all below their respective December means; the temp. of the night compared with that of the day was very low, and the hoar frost and snowfall, although slight, stopped altogether solar radiation. On the 22nd the eclipse was well seen here. The last week was the most wintry, particularly Christmas day; the night temp. on the 26th fell to 9° and 7° respectively, and rose on the 29th to 26° and 24°; winds, 11 polar, 11 equatorial, andr 9 calm or variable, and our only gales were on the 14th, 18th, 19th, and 31st, rom S.W. and S., all equinoctial.

CASTLE TOWARD.—The month began calm, dry, and comparatively mild, but was changeable and wet from the 12th to the 18th; thence to end, hard frost, with alternate fog and sunshine. Temp. of earth 18 in. deep, on 1st January, 1871, ground trenched in September, 45°, in October, 44°, November, 43°, December, 41°·5, and undug, 42°.

DEANSTON.—Beginning of month cloudy, and slight frosts, then S, sleet, and R; middle of month wet and stormy. On 21st, S, and very severe frost from 22nd to 28th, the lowest being 23rd, 4°·5, 24th, 16°, 25th, 9°, 26th, 12°, 27th, 6°·8, 28th, 15°·7.

LOGIERAIT.—Intense frost from 21st to 31st; no great depth of S. Eclipse visible for about half-an-hour.

BALLATER.—After the first week very stormy weather throughout; S remained on the ground the whole month, and the frost during the last nine days was very intense, being half-a-degree below zero on 23rd, 3° above on 27th, 5° on 22nd and 28th, and 7° on 26th.

ABERDEEN.—A dull, cold month, with very heavy R; S storm from 21st to

31st, with intense cold ; auroræ on 13 nights ; red aurora a.m. on 14th (and min. bar.) and on 16th ; fine lunar rainbow on the 4th ; temp. on grass on 27th, 4° ; soil frozen 1 ft. 6 in. deep.

PORTREE.—T and L during the night of the 16th ; a heavy gale from the W. the night of 15th, and from the N.W. on the night of the 6th ; continued very squally during the 7th, 8th, and 9th ; H and S on 7th and 8th ; frost from 10th to 13th ; on 21st a very severe frost set in, with N.E. winds ; on the evening of 24th S fell thick till the depth of 10 in. was reached ; it continued fair and frosty up to the 31st, when a heavy gale came on from S., and a thaw set in with R, which continued from 9 p.m. the whole night.

LOCHBROOM.—The first two days were fine ; from 3rd to 18th wet and drizzly, with a great flood on the 17th ; thereafter to the 31st the frost was continuous, and very severe ; a fine thaw set in on the last night. On the whole this has been a bad month for farmers and graziers, telling severely upon their flocks and fodder, and more especially upon the turnips.

SANDWICK.—December has been wetter and colder than the mean, wetter indeed than it has been since 1854, and colder than I recollect December to have been, the exposed min. ther. being as low as 6° on the morning of the 28th ; wind 40 miles an hour from 9 a.m. on 15th to 7 p.m., and 50 miles an hour from 1 to 2 p.m. ; bright aurora coruscating to zenith and to S. on the 17th.

IRELAND.

LECKPATRICK.—The coldest month ever registered here, the mean temp. being nearly 7° below the average ; rainfall a little below the average. The last three months of the year were each much below the ordinary average temp. ; S on 11th and 24th.

END OF VOLUME V.

G. SHIELD, Printer, 30, Sloane Square, Chelsea, S.W.

ERRATA.

The following errors in the monthly tables of rainfall and temperature in Vol. IV. for 1869, have been detected by comparison with the yearly returns from the several stations :—

			Total rain. in.		Total rain. in.
Barnstaple.....	September.....	*for*	6·75	*read*	6·00
Orleton	June	,,	1·12	,,	1·02
Seathwaite	December	,,	17·77	,,	17·75
Logierait	November	,,	2·54	,,	2·50
Portree	June	,,	3·09	,,	3·32
Cork	September.....	,,	5·05	,,	5·15
Killaloe	December	,,	6·19	,,	6·50
Leckpatrick	February	,,	4·22	,,	4·27

The following misprints also exist :—

Page 56—"Migratory Birds," *for* Hillingdon, *read* Hillington.
,, 186—Min. temperatures, Kirkby Lonsdale, *for* —4·0, *read* +4·0.